Investigation on An Electrode-supported Type SOFC Using a YSZ-supported Anode Substrate

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1. INTRODUCTION

Electrode-supported solid oxide fuel cell (SOFC) has higher performance of its electric power generation property and mechanical strength than that of the electrolyte-supported one. CRIEPI has proposed a new stack concept composed of anode-supported single cells with interconnecting layer and porous electrical contacting plates made of porous cathode plate with our original electrical connection material.

In this study, to compare and clarify the electric power generation properties, two type single cells of both the electrolyte- and the anode-supported type were prepared by ceramic-wet process. The cell voltage, j, -current density, V, characteristics and long term stabilities of them were measured.

2. EXPERIMENTAL

Preparation process of the electrolyte-supported cells is described in Ref. (1,2). The porous anode substrates made of yttria stabilized zirconia (YSZ)-supported anode material (1-3) were adapted to the anode-supported cells without the interconnecting layer. The YSZ electrolyte for the anode-supported type was slurry-coated and fired at 1673 K onto the anode substrate several times. The lanthanum manganite cathode powder added terpineol were coated and baked at 1423 K on the YSZ layer with an electrode area of 3.1 cm^2. In tests of the power generation properties at 1273 K, gaseous H_2 humidified by water at 293 K (300 cm^3/min) as a fuel and air (1000 cm^3/min) as an oxidant were supplied to the anode and the cathode, respectively. The polished cross section of YSZ layer was observed with an electron probe micro-analyzer.

3. RESULTS AND DISCUSSION

The microstructure of the YSZ layer and anode substrate after the performance test is shown in Fig. 1. It was confirmed that the electrolyte layer with some closed pores is about 30 μ m in thickness, and its microstructure of the anode was similar to our previous studies (1-2,4).

Figure 2 shows the j-V characteristics of the respective single cells. It is found that the characteristic of the anode-supported cell is higher than that of the electrolyte-supported one. The anode-supported cell reached approximately 2.25 A/cm^2 of j at 0.60 V of V, although the electrolyte-supported one was limited to about 1.27 A/cm^2. Moreover, the YSZ layer of the anode-supported was seemed to be gas-tight because their open circuit voltages were equal to theoretical value (about 1.07 V).

The properties under long term operation of each cell are compared in Fig. 3. Stability of the anode-supported cell was more excellent than that of the electrolyte-supported one even over 1.20 A/cm^2 of current density.

4. CONCLUSIONS

It is successful that the gas-tight electrolyte layer for the anode-supported cell using our YSZ-supported anode substrate is prepared by the slurry coating method. The present investigation has revealed that the anode supported cell showed a high electric power generation property and an excellent stability under higher current density during long operation compared with the electrolyte-supported one.

References
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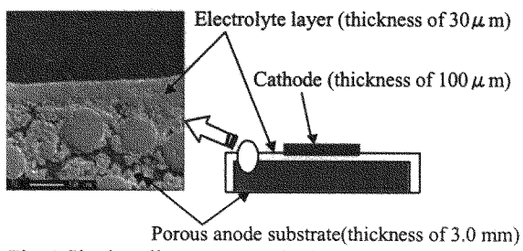

Fig. 1 Single cell structure and microstructure of the electrolyte layer.

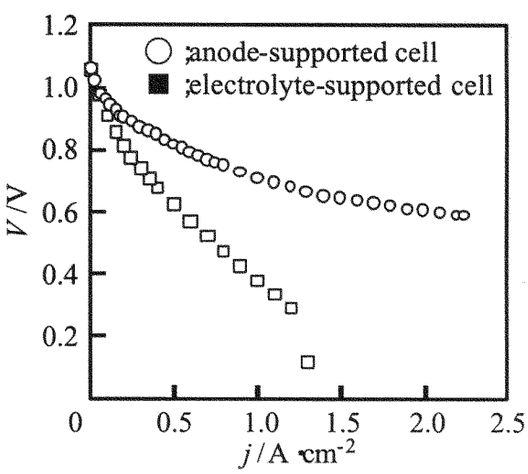

Fig.2 j-V characteristics of the single cells at 1273K. (Electrode area = 3.1 cm^2, $Q_{H2(+H2O)}$ = 300 cm^3/min, Q_{air} = 1000 cm^3/min).

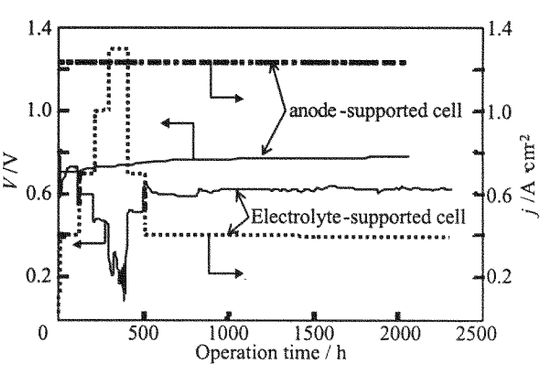

Fig.3 Long term properties for the single cells at 1273K.